Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal Form

Section 1. General administrative information

Salmon Supplementation Studies in Idaho Rivers

Bonneville project number, if an ongoing project 8909800

Business name of agency, institution or organization requesting funding
U.S. Fish & Wildlife Service

Business acronym (if appropriate) IDFG

Proposal contact person or principal investigator:

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Subcontractors. List one subcontractor per row; to add more rows, press Alt-Insert from within this table

Organization	Mailing Address	City, ST Zip	Contact Name
Shoshone-Bannock Tribes	PO Box 306	Fort Hall, ID 83203	Chris Reighn
Nez Perce Tribe	PO Box 365	Lapwai, ID 83540	Jay Hesse
US Fish and Wildlife Service	PO Box 18	Ahsahka, ID 83520	Jill Olson

NPPC Program Measure Number(s) which this project addresses.
7.3B.2, 7.0A, 7.1B.1, 7.1C.3, 7.2A

NMFS Biological Opinion Number(s) which this project addresses.

ESA Section 10 permits, Federal Land Management NEPA compliance

Other planning document references.

If the project type is “Watershed” (see Section 2), reference any demonstrable support from affected agencies, tribes, local watershed groups, and public and/or private landowners, and cite available documentation.

4.5.c., 4.1, 4.1B, 4.2 - Snake River Salmon Recovery Plan:

Subbasin.

Clearwater River, Salmon River

Short description.

Evaluate various supplementation strategies for maintaining and rebuilding spring/summer chinook populations in Idaho. Develop recommendations for the use of supplementation to rebuild naturally spawning populations.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
	Resident fish		O & M	+	Biodiversity/genetics
	Wildlife	+	Production	+	Population dynamics
	Oceans/estuaries	+	Research		Ecosystems
	Climate	X	Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.	X	Supplementation
			Enforcement		Wildlife habitat enhancement/restoration
			Acquisitions		

Other keywords.

Chinook, hatchery-wild interactions, life history, production, genetics, productivity, ESA

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
8909801	US Fish and Wildlife Service	Cooperator on ISS study.
8909802	Nez Perce Tribe	Cooperator on ISS study.
8909803	Shoshone-Bannock Tribes	Cooperator on ISS study.
9005500	Steelhead Supplementation Studies	Reciprocal transfer of data/coordination.
8335000	Nez Perce Tribal Hatchery - O&M	Reciprocal transfer of data/coordination.
9405000	Salmon River Habitat O&M/Monitoring & Evaluation	Reciprocal transfer of data/coordination.
9705700	Salmon River Production Program	Reciprocal transfer of

		data/coordination.
9703000	Listed Stock Adult Escapement Monitoring	Reciprocal transfer of data/coordination.
9102800	Snake River Spring/Summer Chinook Salmon	Reciprocal transfer of data/coordination.
9604300	Johnson Creek Artificial Propagation Enhancement - O&M	Reciprocal transfer of data/coordination.

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Monitor and evaluate the effects of supplementation on parr, presmolt and smolt numbers and spawning escapements of naturally produced salmon.	a	Identify study areas.
1		b	Identify brood stocks and facilities to be used for supplementation.
1		c	Summarize existing knowledge or measure baseline information on habitat and fish populations prior to supplementation and for hatchery facilities and stocks.
1		d	Develop and implement "standardized" spawning, rearing, marking and release protocols.
1		e	Differentially mark all hatchery supplementation and general production fish released in or nearby the study streams.
1		f	PIT tag a minimum of 300 to 700 hatchery supplementation and general production fish released in or nearby the study streams.
1		g	Release various life stages of chinook salmon into study areas for a minimum of one to two generations(5-10 years). Determine fish numbers for each life stage based on existing natural production and natural rearing capacity.

1		h	Estimate late summer parr abundance from snorkeling surveys utilizing stratified random sampling design to provide a coefficient of variation of approximately 15%.
1		I	Pit tag a minimum of 300 to 500 naturally produced parr from each treatment and control stream to estimate smolt production and survival.
1		j	Use existing weirs where possible and construct new weirs downstream of the study area to collect, mark (PIT tag), and enumerate emigrating fish and to identify and enumerate returning adults.
1		k	Compare natural production of supplemented populations to unsupplemented populations and baseline data.
2	Monitor and evaluate changes in natural productivity and genetic composition of target and adjacent populations following supplementation.	a	Monitor productivity and genetic indices from supplemented populations and compare baseline and controls. Productivity characteristics will be evaluated as a function of density or percent carrying capacity to minimize density dependent effects confounding treatment effects.
2		b	Monitor straying of hatchery supplementation fish into adjacent and control streams by weirs and carcass surveys.
2		d	Develop “small scale” experiments to monitor behavioral interactions between natural and hatchery fish.
2		e	Determine spawner to recruitment relationship based on determined production and productivity indices(parr and smolt numbers, adult escapements, survival,

			eggs/spawner etc.)
2		f	Predict population viability based on spawner to recruitment relationship to determine of the population will maintain itself through time in the absence of additional supplementation.
2		g	Predict level and frequency of supplementation required to maintain natural populations at enhanced levels.
3	Determine which supplementation strategies (broodstock and release stage) provide the quickest and highest response in natural production without adverse effects on productivity.	a	Utilize existing hatchery brood stocks during the first generation (5 years) of supplementation.
3		b	Monitor and evaluate natural production (presmolt, smolt and adult numbers) and productivity (survival, life stage characteristics, pathogens, straying, genetic composition) of supplemented populations and compare to baseline and controls.
3		c	Utilize local broodstocks with known natural component from the target population during the second generation of supplementation.
3		d	Compare natural production and productivity indices of supplemented populations using existing hatchery broodstocks (first generation) to populations using locally developed broodstocks (second generation).
3		e	Compare natural production and productivity indices among supplemented populations using parr, fall presmolt and smolt release strategies.
4	Develop supplementation	a	Guidelines and recommendations

	recommendations.		will be developed addressing risks and benefits of supplementation (augmentation and restoration) in general and specific supplementation strategies (broodstock and release stage).

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	05/1992	12/2007	32
2	05/1992	12/2007	32
3	05/1992	12/2007	32
4	01/1999	09/2007	4

Schedule constraints.

The continued decline of spring/summer chinook salmon returning to Idaho resulting in insufficient adult returns to provide target supplementation treatments.

Completion date.
2007

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		370,000
Fringe benefits		138,000
Supplies, materials, non-expendable property		17,200
Operations & maintenance		85,800
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Vehicle replacement, field computers, wet suits.	50,000
PIT tags	# of tags: 15,000	43,500
Travel	Primary costs are field travel (vehicles, etc.), lodging, and subsistence.	36,000
Indirect costs	21.3% of all costs except capital acq.	150,399
Subcontracts		0
Other	Fish marking and genetic analysis	15,600
TOTAL		906,500

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	860,000	890,000	900,000	900,000
O&M as % of total	12%	12%	12%	12%

Section 6. Abstract

The goal of the Idaho Supplementation Studies Project is to evaluate the usefulness of supplementation as a recovery/restoration strategy for depressed stocks of spring and summer chinook salmon in Idaho. The project is a multi-agency effort, covering 30 streams throughout the Salmon River and Clearwater River basins, working to help define the potential role of chinook salmon supplementation in managing Idaho's natural spring and summer chinook populations, and identify genetic and ecological impacts to existing natural populations. The ISS experimental design is split into three main approaches: (1) Large scale population production and productivity studies designed to provide Snake River basin wide inferences. (2) Using study streams to evaluate specific supplementation programs. (3) Small-scale studies designed to evaluate specific hypotheses. Approaches one and two measure population responses to supplementation and are long-term studies. Approach three determines specific impacts of supplementation such as competition, dispersal, and behavior; and are short-term studies conducted in "controlled" environments. We expect this research to demonstrate the best methods for supplementing existing natural populations of chinook salmon and re-establishing natural populations in streams where chinook have become extirpated. We expect supplementation effects and recommendations to be different for each stream. The study design called for a minimum of 15 years of research (three generations). Sampling was initiated in 1991 and implementation began in 1992. The supplementation effects will be monitored and evaluated by comparing juvenile production and survival, fecundity, age structure, and genetic structure and variability in treatment and control streams of similar ecological parameters.

Section 7. Project description

a. Technical and/or scientific background.

This is an overview from the more detailed background and justification found in Lietzinger and Bowles 1991. Supplementation and hatchery activities have existed in the Columbia River Basin since 1878 when the first hatchery was built on the Clackamas River. In 1991 there were ten state and federal hatcheries operating in Idaho.
In 1976 the Lower Snake River Compensation Plan was authorized to mitigate losses resulting from the construction of four lower Snake River dams. Dworshak Hatchery was constructed to mitigate Dworshak dam. The Mitchell Acted mandated the construction of Kooskia Hatchery to help mitigate Columbia River dams. The main purpose of these hatcheries is to restore adult salmon and steelhead fisheries above Lower Granite Dam lost as a result of the development of hydropower. Supplementation has become an important part of hatchery operations even though very little research has been done to

evaluate the effect it has on the natural populations in Idaho and basin wide.

The utility of supplementation as a viable recovery tool is the subject of much debate, which we address briefly in our text (see Potential Results Section). Although sound evaluation has been lacking, there is little doubt that past supplementation efforts have rarely met with success (Smith et al. 1985; Miller et al. 1990; Steward and Bjornn 1990). We believe the verdict on supplementation is still out because previous outplanting programs were typically directed by conventional hatchery guidelines and criteria, and not current natural production and genetic conservation theory. The potential benefits as well as risks associated with supplementation warrant more thorough investigation prior to negating or embracing supplementation as a recovery tool. The following discussion provides a brief synopsis of current knowledge and theory on supplementation effects.

While there has been conflicting evidence, the majority of the research points out that outplanting programs have not been successful, especially when the intent was to boost natural production (Reisenbichler and McIntyre 1986; Miller et al. 1990). Reestablishing runs (i.e. restoration) have shown some success. Salmon with shorter freshwater life cycles and shorter migrations have had higher success than those with longer freshwater residency and longer migrations (Miller et al. 1990). Miller et al. also states that the introduction of "locally adapted" smolts will yield adults but they warn smolt quality must be good (e.g. disease not a significant mortality factor). Wild and natural fish do not perform as well in a hatchery as hatchery fish (Reisenbichler and McIntyre 1977). Fish from distant stocks do not survive as well as fish from the local stocks. Survival decreases as transfer distance increases (Ritter 1975; Kijima and Fujo 1982; Reisenbichler 1988).

With traditional hatchery practices, hatchery fish tend to become a different stock. They adapt to the hatchery and can become different genetically (altered heterozygosity, gene frequency shifts) from the natural/wild stock from which it was derived (Reisenbichler and McIntyre 1977; Steward and Bjornn 1990; McIntyre in press). These changes can be observed in fitness, growth, survival and disease resistance. Hatchery fish have shown increased straying rates compared to wild and natural fish (Steward and Bjornn 1990). This could pose a significant threat to non-target wild stocks.

Offspring resulting from hatchery X wild/natural crosses can have lower fitness for the local habitats. Fitness was found to decrease as differences between hatchery and wild/natural fish increase (Bams 1976; Reisenbichler and McIntyre 1986; Chilcote et al. 1986). Quantification of the relationship between some measure of "distance" (e.g. geographic, genetic) between stocks and resulting fitness of crosses is lacking. Productivity of wild/natural stocks can also be reduced after introgression by hatchery fish (Snow 1974; Vincent 1985, 1987; Kennedy and Strange 1986; Petrosky and Bjornn 1988). Offspring of hatchery adults can have relatively low survival in natural habitats relative to wild/natural offspring (Chilcote et al. 1986; Nickelson et al. 1986). Genetic changes in hatchery fish even over a few generations can affect survival negatively in the natural environment (Reisenbichler and McIntyre 1977; Steward and Bjornn 1990; McIntyre in press).

It is generally felt that supplementation can increase natural production (i.e. total numbers produced) but not natural productivity (e.g. number of adults produced per natural spawner). Reductions in natural productivity can be minimized through proper supplementation strategies so that enhanced production more than compensates for reduced productivity. These same hatchery practices can minimize genetic drift of the hatchery stock away from the local stock from which it was derived by collecting eggs from throughout the run, using wild fish in the egg-take periodically and spawning males and females in a 1:1 ratio (Kapuscinski et al. 1991).

Interbasin stock transfers can result in "serious" risk to the fitness of native stocks. Several biologists have recommended that if a supplementation program is initiated, the hatchery broodstock should be taken from the stock to be supplemented in order to maintain genetic identity and avoid disrupting locally attuned co-adapted gene complexes (Bams 1976, Reisenbichler 1981, 1984; Chilcote et al. 1986; Currens et al. 1991; Kapuscinski et al. 1991; McIntyre in press). Estimates of the number of adults needed to start the broodstock range from 50 (Verspoor 1988) to 500 (Franklin 1980). They also recommend that in order for supplementation to have the best chances of success one needs to understand the ecology of the area (e.g. carrying capacity, survival rates and densities, habitat quantity and quality etc.), factors limiting present production, the unique qualities of the stock, and optimum methods of supplementation.

IDFG spearheaded development of this experimental design to address questions identified in the Supplementation Technical Work Group (STWG) Five Year Workplan (STWG 1988), as well as help define the potential role of supplementation in managing Idaho's anadromous fisheries and as a recovery tool for the basin. Answers to these questions will help determine the best broodstock, rearing and release strategies for augmentation or restoring natural populations in various streams and the effects of these activities on target and non-target natural populations.

The Idaho Supplementation Study (ISS) is being conducted in two phases. Phase I is near completion and included formation of the Idaho Supplementation Technical Advisory Committee (ISTAC), development of a comprehensive experimental design and database, and initial collection of baseline genetic, physical and biological data.

The research plan is a cooperative project involving all the members of the ISTAC. The committee is made up of representatives from the Forest Service (USFS) Intermountain and Northern regions, United States Fish and Wildlife Service (USFWS), Nez Perce Tribe (NPT), Shoshone-Bannock Tribes (SBT), Northwest Power Planning Council (NPPC), Bonneville Power Administration (BPA), Idaho Cooperative Fish and Wildlife Research Unit (ICFWRU), and Idaho Department of Fish and Game (IDFG). Their roles were to technically review and provide input on the research design and coordinate with their respective management, research, and user groups. This insures that long and short term management plans of respective agencies and tribes will not compromise the supplementation research design and that management and research concerns of the respective agencies and tribes were represented in the supplementation research design. Through a subcontract with IDFG, the Idaho Cooperative Fish and Wildlife Research Unit (ICFWRU) assisted directly in the development of the experimental design, with particular emphasis on the genetic and ecological effects of supplementation on natural populations.

The Northwest Power Planning Council (NPPC) has identified supplementation as a high priority to achieve its interim goal of doubling anadromous fish runs in the Columbia Basin (NPPC 1987). This research relates directly to basin-wide needs and concerns addressed in the Columbia Basin Fish and Wildlife Program (NPPC 1987). Section 206(b)(1)(D) mandates supplementation research to assess the potential of supplementation to increase natural production. Section 204(D) stresses the importance of evaluating genetic and ecological effects from outplanting hatchery fish on natural populations. The need to address supplementation questions for upriver stocks is specified in Section 703(h)(1).

In relationship to the objectives of the most recent (1994) Columbia River Basin Fish and Wildlife Program: section 7 "calls for immediate efforts to gather data on wild and naturally spawning stocks, review impact of the existing hatchery system and coordinate supplementation activities." In an attempt to "develop a clear policy to guide the use of supplementation," section 7.3B.2 specifically outlines the need to "implement the high priority supplementation projects including design, construction, operation, maintenance, and monitoring and evaluation."

b. Proposal objectives.

Objective 1. Monitor and evaluate the effects of supplementation on presmolt and smolt numbers and spawning escapements of naturally produced salmon.

H_{01a}: Supplementation-augmentation of existing chinook populations in Idaho does not effect natural production. Corollary: Rejecting H_{01a} indicates that supplementation can enhance or deter natural production.

H_{01b}: Supplementation-restoration utilizing existing hatchery stocks does not establish natural populations of chinook salmon in Idaho. Corollary: Rejecting H01b indicates that existing hatchery stocks can be used to restore natural populations of chinook salmon in Idaho.

Objective 2. Monitor and evaluate changes in natural productivity and genetic composition of target and adjacent populations following supplementation.

H_{02a}: Supplementation-augmentation of existing chinook populations in Idaho does not reduce productivity of target or adjacent populations below acceptable levels (e.g.

replacement). Corollary: Rejecting H_{02a} indicates that supplementation can conversely affect survival and performance of existing populations.

H_{02b}: Supplementation does not lead to self-sustaining populations at some enhanced level (e.g. 50% increase in abundance maintained over time.) Corollary: Rejection of H_{02b} indicates that certain supplementation strategies are successful in establishing self-sustaining populations or enhancing the level at which populations maintain themselves.

Objective 3. Determine which supplementation strategies (broodstock and release stage) provide the quickest and highest response in natural production without adverse effects on productivity.

H_{03a}: Utilization of existing hatchery broodstocks in Idaho is not an effective strategy to supplement existing populations of chinook salmon within local or adjacent subbasins. Corollary: Rejection of H_{03a} indicates that established hatchery broodstocks for supplementation within the local or adjacent subbasin.

H_{03b}: Development of new, local broodstocks with known natural component for supplementation does not provide an advantage over utilization of existing hatchery broodstocks for supplementation within the local or adjacent subbasin. Corollary: Rejection of H_{03b} indicates that development of new supplementation broodstocks from the target populations can be more successful for supplementation than utilization of existing broodstocks.

H_{03c}: The effects of supplementation on natural production and productivity does not differ among life stages (parr, presmolt, smolt) of hatchery fish released. Corollary: Rejecting H_{03c} indicates which supplementation release strategies (life stages) are most effective (or least deleterious) in rebuilding natural populations.

Objective 4: Develop supplementation recommendations.

c. Rationale and significance to Regional Programs.

The Northwest Power Planning Council (NPPC) has called “for immediate efforts to gather data on wild and naturally spawning stocks, review impacts of the existing hatchery system and coordinate supplementation activities” to achieve its goal of doubling anadromous fish runs in the Columbia Basin as addressed in the Columbia Basin Fish and Wildlife Program (NPPC 1994). The research goals of the Idaho Supplementation Studies are to: (1) Assess the use of hatchery chinook salmon to increase natural populations of spring and summer chinook in the Salmon and Clearwater River drainages; (2) Evaluate the genetic and ecological impacts of hatchery chinook salmon on naturally reproducing chinook populations. The relationships between FWP (1994) and ISS research objectives are reviewed below:

Section 7.3B.2 -Research Objective 1-3 (Implementation Phase): Implement the high priority supplementation including monitoring and evaluation (among others).

Section 7.0A - Research Objectives 1 and 3: Identify which supplementation strategies (broodstock and release stage) will be most affective in increasing natural production without adverse effects on productivity.

Section 7.1B.1- Research Objective 2: Monitor and evaluate changes in natural productivity and genetic composition of target and adjacent populations following supplementation.

Section 7.1C.3 - Research Objective 2: To establish a baseline profile for evaluation and monitoring, we will include a genetic profile analysis for treatment and control streams.

Section 7.2A - Research Objectives 1- 4: Based on the results of each of the objectives we expect to document which methods are best for supplementing existing naturally reproducing populations of chinook salmon and re-establishing naturally producing populations in stream where they have been extirpated.

Supplementation in Idaho parallels basin wide needs and concerns as well as addressing unique concerns for upriver stocks. There are supplementation projects ongoing in Washington, Oregon, and Idaho. These projects have been reviewed to enhance coordination and integration with ISS and to avoid unnecessary duplication of effort. A major contributor in this effort has been our participation in the Regional Assessment of Supplementation Project (RASP). There are also numerous supportive research or monitoring projects in Idaho that are not studying supplementation but will provide valuable data for ISS. These include IDFG, Sho-Ban Tribes, Nez Perce Tribe, USFS, NMFS, and ICFWRU. Supportive information includes parr density estimates, redd counts, habitat characteristics, spawning distribution and behavior, fish marking, rearing and density effects, and pathogen screening.

d. Project history

- summary of major results achieved
- past costs (see attached spreadsheet)

The Idaho Salmon Supplementation (ISS) Studies in Idaho Rivers project started in 1989 as project 89098, (Idaho Department of Fish and Game, current project 8909800) . In 1992, the Nez Perce Tribe, Shoshone-Bannock Tribes, and U.S. Fish and Wildlife Service were funded to assist in the ISS project as cooperative agencies with project numbers of 8909802, 8909803, and 8909801, respectively. The University of Idaho, Idaho Cooperative Fish and Wildlife Research Unit was funded to conduct small-scale investigations for the Idaho Department of Fish and Game under the ISS study.

Publications and reports to date include the initial study design (Bowles and Leitzinger 1991), small-scale studies (Peery and Bjornn 1996), and annual reports: Arnsberg (1993), Hesse and Arnsberg (1994), Hesse et al (1995), Keith et al (1996), Lietzinger et al. 1996, Lietzinger et al. 1993, Nemeth et al. 1996, and Rockhold et al. 1997. A five year summary report encompassing information from all project coordinators is in progress and nearing completion.

ISS data addressing current population levels and life history descriptions for many of the chinook salmon (including ESA listed) producing streams in the Salmon and Clearwater drainages is being utilized in the PATH process, hyrdro-system evaluations, and captive propagation programs.

While not directly implemented for ISS , data collected on ISS PIT tagged chinook (wild/natural and hatchery origin) at Snake and Columbia River passage facilities will aid in mainstem smolt monitoring of time and passage requirements and may contribute to the management/modification of mainstem dam operations. Implementation of captive propagation programs including: stream prioritization, collection techniques, and monitoring and evaluating techniques will use ISS data.

The management strategy, for stocking all 1994 and 1995 brood year chinook salmon as smolts, utilized the preliminary 1992-1994 ISS data analysis that demonstrated higher minimum rates of detection at mainstem fish passage facilities for smolt releases over parr and presmolt released fish.

The ISS study results and recommendations will help guide state, tribal, and federal hatchery programs. Population characteristics including historical resiliency to low return years, life history, and genetic descriptions from base line sampling will play a vital role in determining which supplementation strategy (if any) produces the best adult to adult to production without adverse genetic impacts to natural populations.

The Idaho Department of Fish and Game has been funded for 8 years under project 8909800. Annual budgets for the past six fiscal years were: FY93 - $708,400, FY94 - $849,632, FY95 - $850,002, FY96 - $850,001, FY97 - $833,286, and FY98 - $850,000.

e. Methods.

The specific methods are explained in detail in Salmon Supplementation Studies in Idaho: Experimental Design. Leitzinger and Bowles 1991.

TASKS associated with respective objective and hypotheses as presented in section B:

Task 1.1 Identify study areas based upon research opportunities, general applicability, stock status, management plans, and relative risks.

Task 1.2 Identify broodstocks and facilities to be used for supplementation.

Task 1.3 Summarize existing knowledge or measure baseline information on habitat and fish populations in study areas prior to supplementation and for hatchery facilities and stocks.

Task 1.4 Develop and implement “standardized” spawning, rearing, marking, and release protocols for supplementation programs.

Task 1.5 Differentially mark all hatchery supplementation and general production fish released in or nearby the study stream.

Task 1.6 PIT tag a minimum of 300 to 700 hatchery supplementation fish prior to release for estimating smolt-to-smolt survival.

Task 1.7 Release various life stages of chinook salmon into study areas for a minimum of one to two generations (5-10 years). Determine fish numbers for each life stage based on existing natural production and natural rearing capacity.

Task 1.8 Estimate late summer parr abundance from snorkeling surveys utilizing stratified random sampling designed to provide a coefficient of variation (SEM/mean) of approximately 15%.

Task 1.9 PIT tag a minimum of 300 to 500 naturally produced parr from each treatment and control stream to estimate smolt production and survival. Seining and electrofishing sites for fish collection will be distributed throughout each study stream.

Task 1.10 Use existing weirs where possible and construct new weirs downstream of study areas to collect, PIT tag, and enumerate emigrating fish and to identify and enumerate returning adults.

Task 1.11 Compare natural production or supplemented populations to unsupplemented populations and baseline data.

Task 2.1 Monitor productivity and genetic indices from supplemented populations and compare to baseline and controls. Productivity characteristics will be evaluated as a function of density or percent carrying capacity to minimize density dependent effects confounding treatment effects.

Task 2.3 Develop “small scale” experiments to monitor behavioral interactions between natural and hatchery fish.

Task 2.4 Determine spawner to recruitment relationship based on determined production and productivity indices.

Task 2.5 Predict population viability based on spawner recruitment relationship to determine if the population will maintain itself through time in the absence of additional supplementation.

Task 2.6 Predict level and frequency of supplementation required to maintain natural populations at enhanced levels.

Task 3.1 Utilize existing hatchery broodstocks during the first generation (5 years) of supplementation. (Note: Inability to differentiate natural and hatchery returns preclude use of known natural-component broodstocks during the first generation of supplementation.

Task 3.2 Monitor and evaluate natural production and productivity of supplemented populations and compare to baseline and controls (unsupplemented).

Task 3.3 Utilize local broodstocks with known natural component from the target population during the second generation of supplementation (differentiation of natural and hatchery returns possible through fin clips).

Task 3.4 Compare natural production and productivity indices of supplemented populations using existing hatchery broodstocks (first generation) to populations using locally developed broodstocks (second generation).

Task 3.5 Compare natural production and productivity indices among supplemented populations using parr, fall presmolt, and smolt release strategies.

Task 4.1 Guidelines and recommendations will be developed addressing risks and benefits of supplementation (augmentation and restoration) in general and specific supplementation strategies (broodstock and release stage).

Critical Assumptions:
We assume that mainstem passage and flow will allow for a net replacement/increase in adult to adult production. Our efforts will be negated without improvements in mainstem passage and acceptable water flows.

Potential Risks:
The risks associated with ISS were evaluated under the 1991 draft RASP criteria. ISS treatment streams already have on-going hatchery programs. Consequently, ISS hatchery protocol should pose minimal ecological risk, if any, to the chinook salmon populations in these streams. Risks are primarily associated with not conducting ISS, and failing to identify and implement the best recovery measures resulting in the continued decline or extinction of the population and adversely impacting wild\natural populations through the use of inappropriate supplementation due to lack of information. The use of outmigrant traps and adult weirs impose a limited risk to individual animals in terms of direct mortality and migration alteration.

Treatment Description, Evaluation and Monitoring:
Treatment (e.g. supplementation in general, supplementation with a particular life stage, supplementation with a particular brood source) effects will be tested directly by hypothesis. In general, treatments will be applied for one or two generations (5-10 years) following approximately one generation of pretreatment data. Population responses to supplementation will be monitored a minimum of one generation (5 years) following

supplementation. The experimental units are the study streams themselves.

The ISS experiment design is split into three main approaches. The first level of evaluation are large-scale population production and productivity studies designed to provide Snake River basin wide inferences. The second level utilizes study streams as individual “case histories” to evaluate specific supplementation programs. The third level represents small-scale studies designed to evaluate specific hypotheses. Levels one and two focus on measuring population responses to supplementation and hence are long-term in nature. The third level determines specific impacts of supplementation such as competition, dispersal, and behavior. These studies are relatively short-term and will be conducted in laboratory streams or “controlled” field environments.

There are two categories of case histories for the project as a whole, supplementation of existing natural populations (Salmon River basin) and supplementation of extinct populations (Clearwater River basin). Supplementation effects will be evaluated by comparing weir returns, redd counts, juvenile production, juvenile survival, fecundity, age structure, and genetic structure and variability in supplemented and unsupplemented streams of similar ecological parameters (productivity, geology, habitat quality, etc.).

Final evaluation is ideally dependent on the response of adult escapements to treatments; several interim evaluation points will be useful in indicating initial population responses and test specific hypotheses.   Parr, smolt, and redds will be monitored in each study stream, other evaluation points will be monitored where feasible:

<u>Mid-summer parr</u>- Parr abundance is estimated in all treatment and control streams. Number of parr is estimated with standardized snorkeling techniques utilizing stratified systematic sampling (Scheaffer et. al. 1979) designed to provide a coefficient of variation (SEM/M) of approximately 15%. Parr densities are expanded by strata to estimate total parr abundance within the experimental unit (treatment or control reach).

<u>Fall and spring emigrants (presmolt and smolt)</u>- Juvenile emigration numbers and timing are estimated with outmigrant (screw traps) traps. Traps are operated to sample the fall and spring emigration period until icing or water velocity is prohibitive. Capture efficiency is estimated by recapture of marked emigrants transported above traps. Capture efficiencies are monitored as a function of stream flow and water temperature.

<u>Smolt Production</u>**-** Minimum survival estimates of smolts reaching Lower Granite Pool is estimated for all treatment and control streams. Approximately 300-500 juveniles are PIT tagged prior to or during emigration from the study streams and hatcheries. A similar number of hatchery fish are PIT tagged prior to release into treatment streams. Naturally produced parr and emigrants will be PIT tagged following collection by seining, minnow traps, electrofishing, or emigration traps.

<u>Adult escapement</u>- Escapement is determined by adult weirs located located in some

study streams. Multiple redd counts are used in treatment and control streams, wether weired or not, to estimate escapement. Potential spawning area is censused.

This study is concerned with chinook salmon and the number of fish supplemented is proportional to the amount of production in any given year. Fish size at release and time of release will be consistent to eliminate those variables.

Methods for data analysis:
The Experimental Design outlines statistical procedures to be used in data analysis. If substantive changes are made to the Experimental Design in the future, new statistical methods will be prescribed. Supplementation effects will be evaluated using repeated measures profile analysis (split plot through time) to test the response of populations to treatments over time as compared to untreated streams. To help partition variability, some hypotheses utilize a block design. Depending upon the specific hypothesis, blocks may include status of existing population, brood source, life stage outplanted, and stream productivity.

Expected Results:
We expect this research to document the best method for supplementing existing naturally reproducing populations of chinook salmon and the best method for re-establishing naturally producing populations in streams where chinook have become extirpated. Because study streams have different ecological characteristics, supplementation effects and recommendations will likely be different for different streams.

f. Facilities and equipment.

Facilities are adequate for this job. IDFG personnel participating in this project are stationed at the IDFG Nampa Research Office and at IDFG Regional Offices in Lewiston, McCall, and Salmon, Idaho. The project utilizes existing hatchery facilities in the state (Sawtooth, Pahsimeroi, McCall, Rapid River, Clearwater Anadromous). All major equipment needed has been pruchased through previous contracts. Equipment on hand includes, but is not limited to: 7 vehicles, 9 juvenile screw traps, 5 PIT-tag stations, field computers for PIT-tag stations, office computers, printers, photocopiers, miscellaneous field equipment including nets, seines, wet suits, trailers for field lodging, camping gear for remote field work. Equipment is stored in a separate storage building at the Nampa Research Office.

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Section 8. Relationships to other projects

ISS is a cooperative effort between the Idaho Department of Fish and Game, U.S. Fish and Wildlife Service, the Nez Perce Tribe, and the Shoshone-Bannock Tribes. Each cooperating agency has responsibility for investigation of different streams within Idaho. All cooperators meet together to plan project activities and discuss adaptive changes necessary to maintain project relevancy and effectiveness.

Each ISS cooperator completes requirements for National Environmental Policy Act (NEPA) with land management agencies where project activities occur on public land. ESA section 10 permits are also acquired through the National Marine Fisheries Service.

ISS collects a tremendous volume of data and much of it is requested by numerous entities in the Salmon and Clearwater drainages including: Idaho Fish and Game regions/headquarters, US Forest Service, Bureau of Land Management, NMFS, US Fish and Wildlife Service, private landowners, hatchery managers, etc. Many entities rely on the information we collect in making management decisions.

PTAGIS, administered by the Pacific States Marine Fisheries Commission, enables and assists in the use, interrogation, and data base management of Passive Integrated Transponder (PIT) tags.

ISS works closely with Lower Snake River Compensation Plan (LSRCP) to coordinate on hatchery supplementation treatments.

Section 9. Key personnel

Project leaders are Peter F. Hassemer and Jody Walters. Mr. Hassemer is a

Principal Fisheries Research Biologist with IDFG. He has worked for the IDFG for eight years, with six of those years in fisheries research. He received a B.S. (1979) and M.S. (1984) in Fisheries Science from the University of Idaho.

Mr. Walters is a Fisheries Research Biologist with IDFG. He has worked as a fisheries biologist for the Wisconsin Department of Natural Resources, and the Arizona Game and Fish Department. He received a B.S. in Biology from the University of Wisconsin-Stevens Point (1986), and an M.S. in Zoology from the University of Arkansas (1993).

Mr. Lockhart is a Senior Fisheries Technician with IDFG. He has worked two years as a Research Assistant for the University of Nevada, Las Vegas (fish life histories and limnology), thirteen years in general fisheries management and law enforcement for IDFG, and six years intensive life history research on steelhead trout and chinook salmon for IDFG. He received a B.Sc. in Zoology from the University of Nevada, Las Vegas (1973) and has attended graduate school two years at University of Nevada, Las Vegas (Aquatic Biology) and two years at University of Idaho (Managerment of Natural Resources).

Section 10. Information/technology transfer

Technical information is distributed through annual progress reports for individual study sites. A five year progress report including information from all project coordinators will be completed shortly. In 2007, a final project report will be completed. Project cooperators meet regularly to exchange information and discuss project adaptations.

ISS cooperators collect a large volume of data, and much of it is requested by numerous entities in the Salmon and Clearwater drainages including: Idaho Fish and Game regions/headquarters, US Forest Service, Bureau of Land Management, National Marine Fisheries Service, US Fish and Wildlife Service, private landowners, hatchery managers, etc. Many entities rely on the information we collect in making management decisions. There is a tremendous amount of information transfer between ISS and other entities.